# Labor and Population

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RAND Program

# The Dangers of Smoke Haze
## Mortality in Malaysia from Indonesian Forest Fires

Between April and November of 1997, a widespread series of forest fires in Indonesia—particularly in the provinces of Sumatra and Kalimantan—threw a blanket of thick, smoky haze over a large portion of Southeast Asia. As shown on the map, the smoke from the forest fires traveled hundreds of miles across the Southeast Asian region, reaching all the way to the southern parts of Thailand and the Philippines; however, the most severe effects were felt in Singapore, Malaysia, Brunei, and, of course, Indonesia itself. All told, about 70 million people lived in areas affected by the smoke haze.

An important research and policy concern is whether the smoke haze caused by the forest fires had significant health or mortality effects. Unfortunately, appropriate data are not available to examine these effects in Indonesia, the country most affected by the fires and smoke haze.

As a result, Narayan Sastry assembled data from Malaysia to study the mortality effects in that country of smoke haze from the Indonesian forest fires. In particular, he used mortality data from Malaysian vital statistics records; air quality information on the capital city, Kuala Lumpur (from daily measurements made by the Malaysian Meteorological Bureau); and climate data from the U.S. National Oceanic and Atmospheric Administration's Global Weather Station Database.

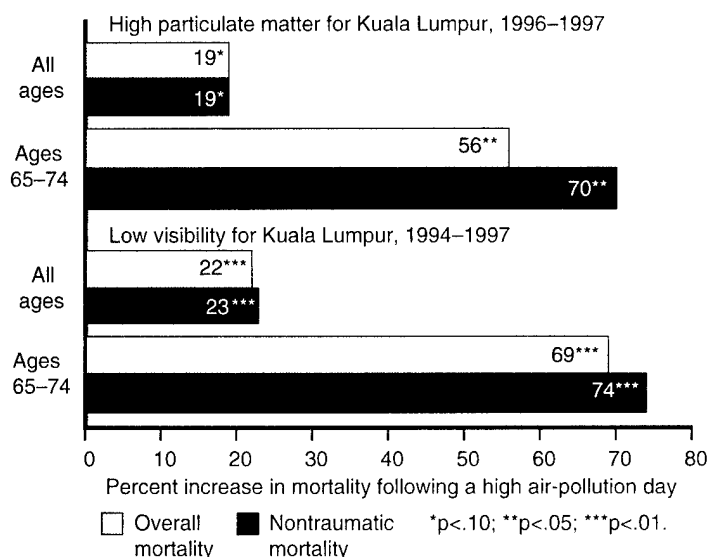## WHAT MEASURES ARE USED IN STUDYING AIR POLLUTION AND MORTALITY?

In studying smoke haze and mortality, two different measures of air pollution were used. The atmospheric pollutant that most consistently increases with biomass smoke is suspended micro-particulate matter under 10 microns in diameter (referred to as $PM_{10}$). Thus, the first and best measure uses $PM_{10}$ and is based on a high air-pollution day (defined as $PM_{10} > 210$ micrograms per cubic meter). The second measure, visibility, provides two extra years of data; a low-visibility day corresponds to a day when visibility is down to .91 km.
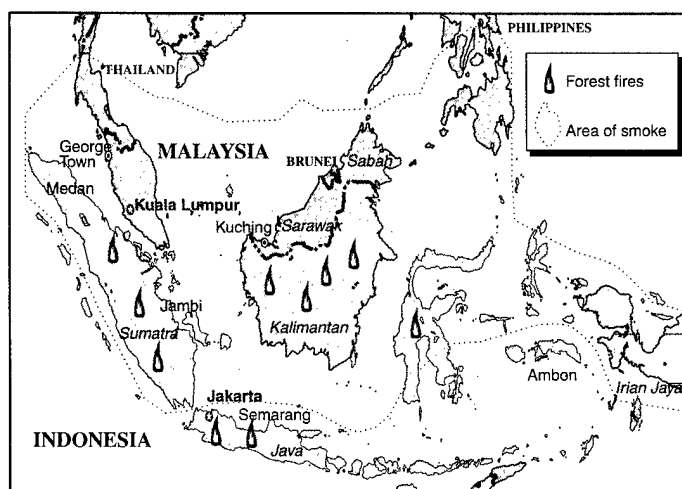


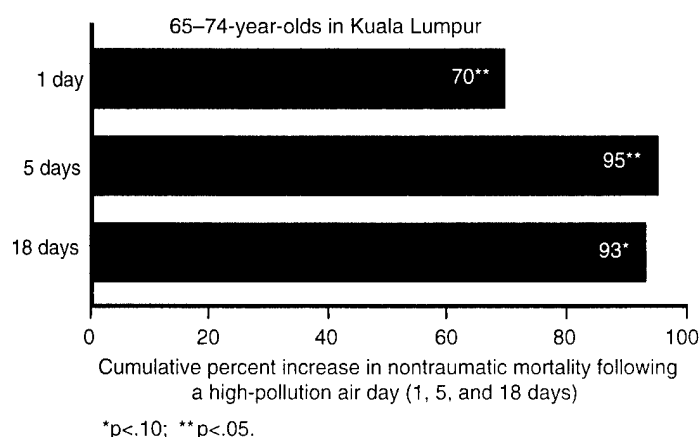## HOW MUCH DOES A HIGH AIR-POLLUTION DAY AFFECT MORTALITY IN MALAYSIA?

The significant results from the two measures are shown in the first bar chart (see reverse) for different age groups. For the "All ages" group and for mortality overall, the $PM_{10}$ and visibility measures show a 19 and 22 percent increase in mortality after a high-pollution day, respectively. The increase in mortality from nontraumatic causes (shown in the black bars), which is the best overall measure because it excludes traumatic deaths (i.e., accidents and injuries), is about the same. Percent increases in overall mortality for those age 65–74 (who are among the most vulnerable) are substantial for both $PM_{10}$ and visibility measures—56 and 69 percent, respectively—and for nontraumatic mortality the increases are even greater.

The results shown so far have looked at the one-day lagged mortality effects of high air-pollution levels, which represent the immediate consequences of exposure to smoke haze. The larger question is whether there is a longer-lasting effect on mortality. The burden of premature death depends on effects beyond those simply due to "harvesting"—in which a pollution event increases mortality among the frail but not the nonfrail, thus leading to

## High particulate matter for Kuala Lumpur, 1996–1997

All ages: 19* (Overall), 19* (Nontraumatic)

Ages 65–74: 56** (Overall), 70** (Nontraumatic)

## Low visibility for Kuala Lumpur, 1994–1997

All ages: 22*** (Overall), 23*** (Nontraumatic)

Ages 65–74: 69*** (Overall), 74*** (Nontraumatic)

Percent increase in mortality following a high air-pollution day
0, 10, 20, 30, 40, 50, 60, 70, 80

□ Overall mortality   ■ Nontraumatic mortality   *p<.10; **p<.05; ***p<.01.

harvesting during the event and fewer deaths during subsequent days but not in the more distant future.

The second bar chart investigates the harvesting issue by showing the cumulative percent increase in nontraumatic mortality for the $PM_{10}$ measure for the 65–74 age group. (No long-term effects are present for other age groups.) It shows the cumulative effects at the longest possible lag times that were statistically significant at the .05 and at the .10 significance levels. The figure shows that for the 65–74 age group in Kuala Lumpur, the mortality effects are persistent, with a cumulative increase in nontraumatic

## 65–74-year-olds in Kuala Lumpur

1 day: 70**

5 days: 95**

18 days: 93*

Cumulative percent increase in nontraumatic mortality following a high-pollution air day (1, 5, and 18 days)
0, 20, 40, 60, 80, 100

*p<.10; **p<.05.

mortality of 95 percent over a five-day period. And the effects are almost as large and even more persistent at the .10 level of significance—93 percent over 18 days.

Except for mortality among the elderly age 65–74 in Kuala Lumpur, the effects of a high air-pollution day are short-lived. For all-age mortality, higher mortality one day after a smoke-haze episode is offset by lower mortality on the following day, indicating that for other age groups the frail are, indeed, being "harvested."

## IMPLICATIONS

The 1997 forest fires in Southeast Asia were an environmental disaster, in terms of their intensity, extent, duration, and the number of people affected. The results of this study show that the smoke haze significantly increased the mortality burden for the population in Malaysia, having large effects for seniors, the most vulnerable members of the population. And although the mortality burden was very short-lived for most age groups, it was more persistent (up to 18 days) for those age 65–74.

Bad as the mortality results are, they are sentinel indicators and are thus suggestive of wider short-term health impacts, particularly with respect to acute illness. There may also be long-term health effects associated with exposure to elevated levels of air pollution over an extended period.

Moreover, while the effects in Malaysia are large, those in Indonesia itself are likely to have been tremendous. Unfortunately, as noted earlier, there are no appropriate health or mortality data available to study the issue directly.

Finally, Indonesia has a poor record in enforcing existing policies to prevent forest fires and an absence of new policy initiatives. These problems, combined with major and continuing economic and political upheaval, suggest that the recent disasters will probably be repeated. Despite this, there is a clear need to develop successful efforts to prevent and contain forest fires; such efforts will have important economic and health benefits throughout the region.